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AUTHOR Scott, Andrew M.
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ABSTRACT

Concepts, tools, and a methodology are needed which will permit the analysis of emergent socio-biospheric problems and facilitate their effective management. Many contemporary problems may be characterized as socio-biospheric; for example, pollution of the seas, acid rain, the growth of cities, and an atmosphere loaded with carcinogens. However, these problems are not yet perceived as proper subjects for systematic study. Because the tendency to focus on single problems is strong, the development of insights and managerial tools is impeded. Yet, socio-biospheric problems do have shared features, some of which are a pattern of onset, rate of development, magnitude at a given moment, duration, intervention options, and means for assessing the impact of intervention. Socio-biospheric problems involve large numbers of actors who create (not willingly) these problems as a result of their day-to-day activities. The processes are usually slow and cumulative, and often interact and converge with one another. Unfortunately, the rate at which problems are produced and at which they are disposed of can vary independently. A factor which further restricts the ability to create a methodology to deal with these problems is that uncertainty and complexity in the global system are sharply increasing. However, planning is essential to the management of global affairs and may be enhanced by improving the theory and quality of analysis, making values more explicit, and making effective use of prior experiences. (KC)

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THE STUDY OF SOCIO-BIOSPHERIC PROBLEMS

Andrew M. Scott
Department of Political Science
University of North Carolina--Chapel Hill
Chapel Hill, North Carolina 27514

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THE STUDY OF SOCIO-BIOSPHERIC PROBLEMS

Within the field of international relations there is a fairly extensive and rich literature dealing with the comparative study of political crises, including those involving the onset of war. Despite the increasing number and prominence of socio-biospheric problems however, there is no corresponding body of literature. The deficiency is of some moment.

1. The Need for a Comparative, Aggregative Approach to Socio-biospheric Problems

If one asks why the deficiency exists the answer is that those working in international relations have traditionally centered their attention on political matters. Only in the last decade has the study of economics been accepted as important and a legitimate component of the field. If something as central as international political economy has only recently won acceptance, it is hardly surprising that matters relating to environment and resources still tend to be treated as peripheral.

Whenever a socio-biospheric change comes to constitute a challenge about which something must be done, it has, in fact, automatically become a political problem as well. If the challenge is to be acted upon, a response must emerge from an intricate set of international political processes. One can therefore argue that it is as important to monitor the <u>response</u> to the acid rain problem, say, as it is to monitor the conditions of acid rain themselves.

The redefinition of the subject matter of international relations has not kept up with the evolution of the global system itself however. Socio-biospheric problems, which have become intrinsically significant, have yet to win full acceptance from the international relations fraternity. In the real world those matters are of first importance: within the discipline they are still on the fringes.

A start needs to be made toward the development of a body of knowledge dealing with socio-biospheric problems that is systematic and both comparative and aggregative, even if first steps are sure to be halting and uncertain. Concepts, tools, and a methodology are needed which will permit the analysis of that range of emergent problems and facilitate their effective management.

Socio-biospheric problems, taken together, are not yet perceived as proper subjects for systematic study. Instead, each problem is dealt with separately as it comes down the road. The tendency to focus upon single problems is very strong. That focus, however, unrelieved, is inefficient and ill-advised. It encourages the the production of extremely useful case materials but it deters researchers from fashioning a knowledge base that incorporates insights about individual problems and then moves beyond them toward codification and generalization. It impedes the development of needed insights and managerial tools.

The presumption underlying this approach is that each problem is unique and its study and management must therefore constitute a unique activity as well. Each problem does indeed have unique features, to be sure, and no problem is a duplicate of any other, but there are usually shared features as well. In many fields of inquiry advances are made more speedily when investigators do not let the existence of the unique close their eyes to the presence of the shared as well. Global problems, of the kind discussed in this paper, may all have features such as the following:

— a cause or causes;
-- a path or pattern of onset;
— a rate of development;
-- a magnitude at a given moment;
— a probable duration;
-- vulnerability to analysis of one kind or another;
— intervention options and a set of possible intervention strategies;
— estimates of required lead-time for each form of intervention;
-- means for assessing the impact of an intervention.

A focus on the singular is not only inefficient it is dangerous. It is dangerous because it falsifies the existing situation and obscures its gravity. Attention should be focused not alone on individual problems but on the constellation of problems that must be dealt with, on the aggregate of difficulties that exist at a given moment.

It is dangerous, furthermore, because, by directing attention away from the macro situation, it reduces the likelihood that change in that situation will be readily perceived. If one variable to be monitored is the response to problems, then surely another would be change in the number and magnitude of problems for which a response is required. May there be a macro-trend toward an increase in the number of problems with which the global system must deal?

New and unanticipated problems have been appearing in recent decades at a rate that has been high and may have been increasing. A partial list of problems now attracting attention that drew little or no attention a few years ago would include:

-- Loss of productive soil on a global basis (as a consequence of salinization, desertification, and deforestation, particularly in tropical areas);
-- the CO_2 problem;
-- species eradication and the loss of biological diversity;
-- groundwater contamination and a prospective global shortage of fresh water;
-- the impact of hazardous substances on ecosystems and humankind;
-- mutagenicity;
-- arctic haze and its possible impact on arctic climate and ecologies;
-- chlorofluorcarbons and the ozone layer;
-- acid rain;
-- population growth and global "carrying capacity";
-- rapid global urbanization, with all that that entails;
-- nuclear proliferation;
-- assorted international economic difficulties and instabilities (an energy problem; the indebtedness of developing nations and the instability of the international banking system; structural inequities and North-South relations; the impact of multinational corporations on development and on the global economy, etc.).

There can be little doubt that tomorrow and the day after will reveal other emergent problems, even if the first suspicion of their nature has yet to darken our minds. At best the new problems will be challenging and, at worst, quite threatening. Apart from the separate difficulties that each will present, what will be their total impact and what degree of responsiveness will they demand from the global community when they are taken all together? The most significant structural vulnerability of the global system is perhaps not to be found in conjunction with any particular socio-biospheric problem but may derive from the juxtaposition of two things: a) a high rate of problem production; b) a low and slow rate of response to global problems.

2. Characteristics of Socio-biospheric Problems

Many contemporary problems might be characterized as socio-biospheric--pollution of the seas, CO_2, acid rain, population growth, the growth of giant cities, the emergence of an atmosphere increasingly laden with carcinogens, and so on. Intuitively, we sense that that kind of problem seems to belong to a different species than, say, Soviet-American relations or Arab-Israeli relations. What are some of the characteristics that distinguish the two species? What are the common features of problems termed "socio-biospheric"?

1. As a rule, in socio-biospheric problems, large numbers of actors are involved and help contribute to making of the problem. No single actor or small set of actors controls the situation or has a significant impact upon it.
2. The actors involved will not only be numerous, they are likely to be of many kinds. Contributing to the CO_2 problem, for example, are millions of private individuals, multitudes of private economic enterprises, a great many public enterprises, and large numbers of governments (local, provincial, national), and so on.
3. The emergence of a socio-biospheric problem is not willed by the actors involved. Instead, it emerges as a by-product of their normal, day-to-day activities.
4. How does this happen? As a consequence of unplanned processes, multitudes of micro-actions are caught-up and metamorphosed into a few macro problems. The processes that bring this about are apurposive, little-understood, and seldom the objects of close attention. Because these processes are not under effective control, it is unavoidable that they should produce inadvertent consequences--the various socio-biospheric problems that must be dealt with: global inflation, ozone layers problems, and so on.

5. The processes that produce socio-biospheric change are often slow-moving. This means that the onset of problems produced by those processes will often be gradual as well. (More accurately, it should be said that those processes seem slow-moving. They seem slow-moving because of the short time-frames in which individuals normally view such things. Viewed in a longer time-frame, say thirty to fifty years, these processes will seem to move along at a good tempo and problems will therefore seem to emerge rather quickly.)
6. The consequences of such problems are often (but need not be) cumulative. This year's carbon dioxide emissions aggravate the existing problem. Next year's soil erosion will compound what was already a serious problem. New borrowing by the developing nations will make a bad situation worse. The movement of population into super-cities during the 1980's will make the problems of those cities worse than they now are, and so it goes.
7. Because these problems are often cumulative in nature, a slow-developing, relatively unimportant problem can become, in time, a fast-moving, significant one. For example, in only a few years, the management of hazardous waste has become a serious problem in developed countries. It will become more grave with continued economic development and technological advance.

8. A substantial delay in addressing a cumulative problem means that it may become increasingly difficult to manage and contain.

9. The processes that produce socio-biospheric problems sometimes interact with one another and the consequences deriving from these processes may also converge. For example, various economic processes feed into one another and help to constitute what might be viewed as a single economic problem, world-wide in scope, albeit one with many different facets. This interaction and convergence of processes and problems may be termed "aggregation", and is one of the most pervasive and significant features of the contemporary scene.

10. As problems and processes aggregate the scope of resulting problems increases sharply.

11. As problem X aggregates with Y, and as they both interact with Z, the complexity of the ensemble will increase rapidly and will vastly exceed the degree of complexity associated with the individual problems before they became intertwined.

12. After problems undergo successive aggregations, their complexity and the degree of their entanglement is often such that the component parts can no longer be successfully disaggregated for purposes of analysis or action. In general, the greater the degree of aggregation the more difficult will be analysis and successful management.

13. Because socio-biospheric problems commonly involve many actors and problem aggregation, high levels of social and political mobilizaton are usually required if they are to be dealt with. This mobilization is likely to necessitate cooperative action by numbers of sovereign nations.

14. Other things being equal, the greater the degree of social and political mobilization required to deal with a problem, the longer the problem lead-time must be. It takes time for actors to agree on such matters as: Is there a problem? How serious is it? Who or what caused it? How should it be dealt with? Who should bear what part of the cost of action?

15. Socio-biospheric problems result from apurposive processes and, as a rule, aggregation. They are by-products of such processes. That being the case, and since such processes are evident on every hand today, it is likely that new socio-biospheric problems will continue to emerge.

16. The processes by which socio-biospheric problems are created and those by which they are disposed of are quite different. No governor has been installed to make certain that the two work at the same tempo, so the rate at which problems are produced and the rate at which they are disposed of can vary independently.

17. At present, it appears that new socio-biospheric problems are being created faster than they are being disposed of. It is easy to find new problems (see Introduction); it is less easy to find significant socio-biospheric problems that have been disposed of. If this observation is correct, difficult times lie ahead.

18. If these characteristics were combined in a certain way, a given problem might become, for all practical purposes, irreversible. That is, if a socio-biospheric process were cumulative, were moderately rapid in its rate of development, were relatively advanced before it came under observation, and required a long lead-time for action, then it might not be possible to turn the process around, given existing political and scientific realities. In an era of socio-biospheric processes and problems, the potential for irreversibility is sobering.

3. Decision-making in the Context of Uncertainty

Uncertainty is a powerful and pervasive constraint on decision-making in international affairs and its significance appears likely to increase rather than decline. As a subject of inquiry, however uncertainty is difficult to handle because it can have so many different foci and because the remedies for it are themselves clouded in uncertainty. One thing is certain nevertheless, its implications are extensive and troublesome.

a. Different Foci of Uncertainty

Even if attention remains on a single issue, the focus of uncertainty will shift with the passage of time and the evolution of that issue. At the outset for example, there may be uncertainty concerning whether there is a problem at all, while later uncertainty may center on the magnitude of the problem. In the course of the evolution of a typical problem the following are some of the foci of uncertainty that might move to center stage and then off into the wings:

-- Do we have a problem?

-- If there is indeed a problem, what is the broader context in which it has emerged?

-- What is its nature? How shall we define the problem for purposes of comprehension and action?

-- What is its magnitude?

-- What caused it and what forces are currently at work in connection with it?

-- How thoroughly is problem X tied in with ancillary problems Y and Z? Are they produced by similar processes, or processes that interact with one another? Do their consequences converge?

-- Can problems X, Y, and Z be decomposed realistically and be treated separately?

-- Since allowance must often be made for long lead-times, what may be the impact on the composite problem XYZ of actions already taken?

-- What are the likely consequences of problem X if no action is taken? Are there second and third order consequences to be aware of?

-- What is the probable rate at which the problem is developing? How long will it be before its full consequences begin to be felt?

-- How soon should we try to be prepared to act on the problem? Does it appear that its deadline will allow sufficient time for it to be comprehended, for support to be mobilized, and for action to be taken?

-- If the problem is cumulative, how serious are the penalties for failure to act by the deadline? What, in other words, does the curve of increased consequences look like?

-- What are some of the ways in which the problem might be dealt with? Which of those options seems most promising?

-- How effective is that mode of intervention likely to be? How long will it take for the consequences of the acton to be felt?

-- What are the probable costs associated with an effort at intervention?

-- What are the other problems competing for attention and scarce resources? How does problem X compare with them and what should priorities be?

-- Does it seem likely that sufficient international agreement can be found to allow action on the problem? How long will it take to get that agreement? How does that time compare with the action deadline for the problem itself?

-- If there is error in some of these estimates (about the deadline, the rate at which the problem is developing, etc.) how threatening will the consequences of that error be?

The progression from one focus to another is seldom orderly however. Debate may simultaneously involve three or four different foci with the attention of different actors directed at different matters.

b. The Inescapability of Uncertainty

Highly complex social systems, by their very nature, are probabilistic rather than deterministic. When there are multitudes of actors, a variety of motivations at work, and rich arrays of options to select from among, it cannot be otherwise. The global system satisfies that description and is, therefore, probabilistic.

A number of interesting implications are associated with that characteristic:

-- Uncertainty is inescapable in probabilistic systems, and is therefore inescapable in the global system. Uncertainty may sometimes be reduced, as a consequence of effort, but it can never approach zero. Outcomes will remain uncertain even if the analyst has perfect information.

— The amount of uncertainty in a complex social system will be related to its variety, complexity, degree of internal interaction, and rate of innovation.

-- Since the end of World War II, the complexity, interaction, and rate of innovation in the global system, has increased sharply. (There are more actors and new kinds of actors--nation-states, governmental agencies, multinational corporations, international governmental organizations, international non-governmental organizations. New forms of unilateral action have emerged--aid programs, cultural exchange programs, military programs, covert action--as well as forms of multilateral action. Technological innovation has also proceeded rapidly, with significant developments following on the heels of one another or seeming to come simultaneously.) For that reason, uncertainty in the global system has also increased sharply.

— Uncertainty no longer makes an occasional appearance; the system is pervaded by it. Gradually, over a period of time,

humans have created a world in which uncertainty levels are extremely high.

-- Furthermore, it appears likely that uncertainty will become more pervasive. If the variables that affect uncertainty (variety, complexity, interaction, rate of innovation) continue to evolve as they have been doing, uncertainty must increase. This points toward a future in which the global system will be bathed in uncertainty.

-- Policy making must therefore go forward under conditions of uncertainty and policy-makers must expect to be increasingly constrained by it.

-- The information and understanding required for the successful management of a given problem is not fixed but varies with the problem's complexity. That is, if nations are working on a problem, they will have a particular set of information needs and will have to achieve a given level of understanding if their management efforts are to be successful. If the processes that create that problem were to combine, over a period of time, with the processes that create another problem, the information and understanding required for the successful managing of the combined problem would have increased greatly.

-- As the complexity of a system increases, information and understanding must scale upward rapidly if a constant management capacity is to be maintained. If that increase is not maintained, management capacity will become attenuated.

-- As noted earlier, the complexity of the global system has increased sharply in the last four decades and promises to continue to do so. Therefore, if the capacity to manage that system is to be maintained at present levels, let alone be increased, information about the system and understanding of it must be made to climb sharply.

-- In any given instance an actor is often well-advised, before making a decision and setting a train of actions in motion, to seek more and better information and improved analysis. To do so, however, will require the expenditure of time and effort, for information and analysis are not cost-free. At some point, therefore, the actor may have to weigh the trade-offs between better information and analysis, on the one hand, and the need to get on with the action, on the other.

-- Decision-makers, almost always faced with new and complex problems, will almost always feel the need for more and better information and analysis about practically everything. Because of information costs, however, the prescription, "get more information," cannot be universalized. To satisfy

present or emergent information needs concerning the global system would require a diversion of energies into information-gathering and analysis on a scale that would be quite impractical. Even then the effort would be disappointing because of the shortcomings of existing analytic tools in trying to cope with complexity.

-- The need for information and analysis soars rapidly in response to the development of the global system. To the extent that this need is not satisfied at a given time, an information/analysis gap opens up. Observers, aware of the growth of new knowledge, may assume that ignorance is in continuous retreat. Two variables are involved however: 1) the existing store of knowledge and understanding; 2) that which <u>needs</u> to be known and understood if humankind's affairs are to be managed successfully. If the first grows rapidly while the second grows more slowly, relative ignorance may, in fact, increase.

-- If this line of analysis is correct, and if the global system continues to evolve along present lines, the information/analysis gap may grow with the passage of time.

-- Any growth in the information/analysis gap will entail an increase in uncertainty and, therefore, in the frequency of error.

-- Whether uncertainty can be reduced in a given instance would depend on the nature and source of the uncertainty, but the following would be some of the actions that might be taken in an effort to reduce it:

1) seek more information;

2) seek better information;

3) get information at an earlier juncture through the use of improved monitoring facilities;

4) make better use of existing information;

5) improve the quality of analysis and the quality of the theory underlying the analysis;

6) make values more explicit and become more aware of the role that they may be playing in analyses;

7) consider modifying some values;

8) make more effective use of prior experiences that may be analogous;

-- In some instances it may be feasible to reduce uncertainty and the likelihood of error by increased use of redundancy. The designer of a machine may know that error will occur in that machine and may seek to overcome it by building in sufficient redundancy. If one part fails, one or another back-up systems will come into play. Decision-makers might seek to reduce the likelihood of error, in selected instances,

by making use of multiple sources of information, drawing on multiple sources of analysis, and so on. There are practical limits, however, to the use that an be made of the redundancy principle. Whole divisions, bureaus, and agencies cannot be duplicated. The cost of the effort and the administrative friction that would be engenered would quickly become insupportable.

— In a changeful world, that is certain to produce a flow of new and challenging problems, planning must become increasingly important.

-- Planning, and intervention in socio-biospheric processes, presupposes a substantial degree of predictability. Decision-makers are expected to make decisions today based upon estimates of the future. Since projections and forecasts provide the basis for anticipating the future, the degree of their accuracy sets upper limits to the capacity to deal with the future.

-- The uncertainty of the future in this rapidly changing world leads observers to produce divergent estimates and forecasts. If uncertainty ensures predictive diversity, the amount and degree of such diversity may provide a rough measure of the amount of uncertainty that exists.

-- When projections differ in significant ways they cannot all be correct. Where there is substantial uncertainty, that is to say, there must also be error.

— In choosing from among divergent forecasts, decision-makers will be influenced by analytic factors and other factors as well, including political and personal ones. Uncertainty is not only incorporated in the making of forecasts, it appears again, therefore, when choices are made among competing forecasts.

-- A relatively low degree of uncertainty at any one branching of a decision-tree can be transformed into a high degree of uncertainty as the number of branchings to be negotiated increases. Additional bits of uncertainty are picked-up at every stop along the way. The total can swell impressively, for uncertainty is cumulative and multiplicative.

— If uncertainty is inescapable in a probabilistic social system so is error. It is an unavoidable aspect of policy-making under conditions of uncertainty. Realistic planning and policy-making should therefore proceed on the assumption that error is not only possible, but is a virtual certainty. Error-free decision-making is not an available option.

— Planning is essential to the management of global affairs yet the growth of uncertainty undermines the planning process. To

plan, analysts must have a reasonable confidence about the shape of the future, yet uncertainty makes it difficult to see into the future very far or very well. The evolution of the global system that makes planning more essential also makes it more difficult therefore. Perhaps, at some point in the future, the minimum degree of predictability consistent with effective planning and intervention, might come to be more than the maximum allowed by the continued growth of uncertainty.

— If the degree of uncertainty required is greater than the situation allows, will decision-makers learn to adapt? Will they adjust to the fact that they have no recourse but to act on the basis of high levels of uncertainty (i.e., low levels of certainty)? Can they come to accept the fact that error is a normal aspect of decision-making under conditions of high uncertainty, while acknowledging, at the same time, that their errors must often have grievous human consequences? Will they find it possible to consider that error may become more common with the passage of time and its costs may continue to rise?

— How can nations, singly or in concert, intervene confidently in global processes if the wisdom and effectiveness of such intervention is uncertain? Will they find it possible to act together if they come to suspect that an increasing proportion

of interventionary actions are likely to be ineffective or counterproductive? In sum, how much uncertainty can be tolerated in international decision-making processes?